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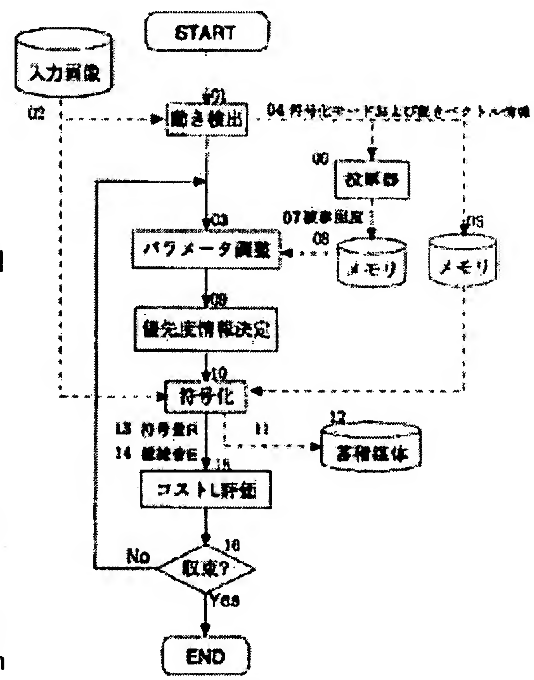
(54) REPEAT VIDEO SIGNAL ENCODING METHOD AND RECORDING MEDIUM WITH RECORDED PROGRAM OF THE METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To determine the unit of a parameter adjustment with which a better optimization than before in the sense of code quantity to noise is performed.
SOLUTION: A motion detector 01 extracts a coding mode and motion vector information 04 of an input image signal 02. The information is stored in a memory 05 and inputted in a vote device 06. A referenced degree 07 is obtained with the vote device 06, and stored in a memory 08. In a parameter adjustment part 03, the degree of the allocation priority of a code quantity corresponding to the referenced degree 07 is determined, and the allocation priority of the code quantity of all small blocks is determined by a priority information determination device 09. An encoder 10 performs the coding of an input image signal 02 based on the information and information from the memory 05. A cost evaluation part 15 obtains a Lagrange cost function L based on a code quantity R13 about the whole image sequence outputted from the encoder 10 and the total quantity E14 of noises. When the value is minimum, the noise quantity to the code quantity is minimum. Then, a convergence decision is performed in a convergence decision part 16.



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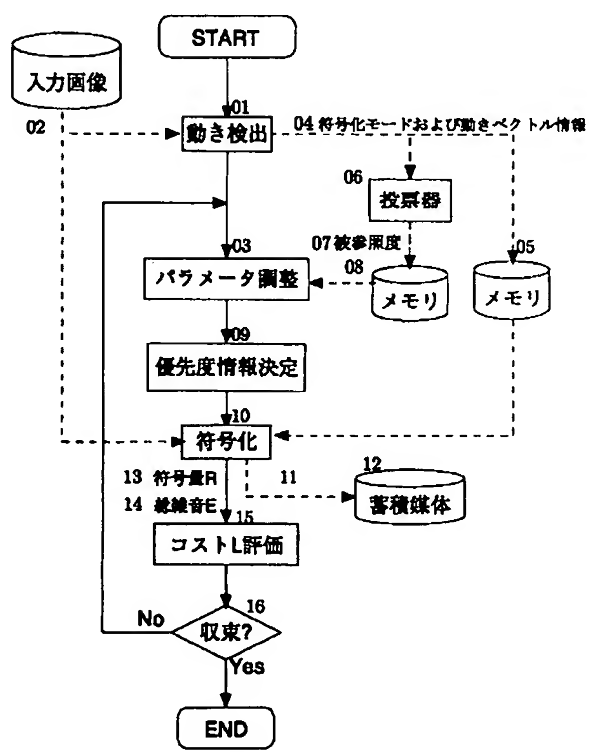
(54)【発明の名称】 繰り返しビデオ信号符号化方法およびこの方法のプログラムを記録した記録媒体

(57)【要約】
【課題】 符号量対雑音の意味で従来よりも良好な最適化が行えるパラメータ調整の単位を決定する。
【解決手段】 動き検出器０１で入力画像信号０２の符号化モードおよび動きベクトル情報０４を抽出する。この情報はメモリ０５に保存され、投票器０６に入力される。投票器０６で被参照度０７を求めて、メモリ０８に保存される。パラメータ調整部０３では、被参照度０７に対応する符号量割り当て優先度の度合を決定し、優先度情報決定器０９で全小ブロックの符号量割り当て優先度が決定され、この情報およびメモリ０５からの情報を元に、符号化器１０で入力画像信号０２の符号化を行う。符号化器１０から出力される、画像シーケンス全体についての符号量Ｒ１３と総雑音量Ｅ１４を元に、コスト評価部１５ではラグランジュコスト関数Ｌを求め、この値が最小となった場合、その符号量に対する雑音の量が最小となる。その後、収束判定部１６にて収束判定を行う。



【特許請求の範囲】

【請求項１】　画像を小ブロックに分割しフレーム間動き補償を行い、さらに同一画像を複数回符号化するビデオ信号符号化方法において、
動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順と、
この被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する手順と、
を有することを特徴とする繰り返しビデオ信号符号化方法。

【請求項２】　請求項１に記載の繰り返しビデオ信号符号化方法において、
前記動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順が、
符号化単位である小ブロック毎に、参照画像フレーム内でその小ブロックが参照している領域へ、小ブロックの属性に応じて所定の量を投票する処理と、
該領域毎に投票された値を加算し、その結果を該領域の被参照度とする処理と、　この処理をそれ以上参照されない画像フレームから参照される画像フレームの順に繰り返す処理と、
を有することを特徴とするビデオ信号符号化方法。

【請求項３】　請求項１に記載の繰り返しビデオ信号符号化方法において、
被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する際、
被参照度とラグランジュの未定乗数を１対１に対応させる表と、
与えられた未定乗数から符号化対象小ブロックのラグランジュコスト関数を求める手順と、
ラグランジュコスト関数を最小にする手順と、
を有することを特徴とする繰り返しビデオ信号符号化方法。

【請求項４】　請求項３に記載の繰り返しビデオ信号符号化方法において、
前記ラグランジュコスト関数を最小にする手順が、
小ブロック毎に、その小ブロックの被参照度に対応するラグランジュの未定乗数に応じて、ラグランジュコスト関数を最小にする量子化パラメータを求める手順と、
画像シーケンス全体のラグランジュコスト関数を求める手順と、
被参照度とラグランジュの未定乗数の対応を変化させ、
画像シーケンス全体のラグランジュコスト関数を最小化する手順と、
を有することを特徴とする繰り返しビデオ信号符号化方法。

【請求項５】　動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順と、
この被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する手順とを、
コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体。

【請求項６】　動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順が、
符号化単位である小ブロック毎に、参照画像フレーム内でその小ブロックが参照している領域へ、小ブロックの属性に応じて所定の量を投票する処理と、
該領域毎に投票された値を加算し、その結果を該領域の被参照度とする処理と、　この処理をそれ以上参照されない画像フレームから参照される画像フレームの順に繰り返す処理とを、
コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体。

【請求項７】　被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する際、
被参照度とラグランジュの未定乗数を１対１に対応させる表と、
与えられた未定乗数から符号化対象小ブロックのラグランジュコスト関数を求める手順と、
ラグランジュコスト関数を最小にする手順とを、
コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体。

【請求項８】　ラグランジュコスト関数を最小にする手順が、
小ブロック毎に、その小ブロックの被参照度に対応するラグランジュの未定乗数に応じて、ラグランジュコスト関数を最小にする量子化パラメータを求める手順と、
画像シーケンス全体のラグランジュコスト関数を求める手順と、
被参照度とラグランジュの未定乗数の対応を変化させ、
画像シーケンス全体のラグランジュコスト関数を最小化する手順とを、
コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、高能率繰り返しビデオ信号符号化方法およびこの方法のプログラムを記録

した記録媒体に関するものである。

【０００２】

【従来の技術】符号量対雑音量の意味で符号化能率を向上させるために同一画像シーケンスについて複数回の符号化試行を許すビデオ符号化方法において、符号化能率の評価には、１８世紀に確立された「ラグランジュの未定乗数法」が応用されている。外部から与えられた未定乗数λに対し、シーケンス符号化時の全符号量Ｒと全誤差Ｅ（この測度は状況により誤差の二乗和であったり、誤差の絶対値和であったりしてよい）から評価基準

Ｌ＝Ｒ＋λ＊Ｅ

を求め、このＬが最小となる方向へ最適化探索（パラメータ調整）を行う。尚、Ｌはラグランジュコスト関数と呼ばれる。

【０００３】従来は、フレーム単位で量子化パラメータあるいはラグランジュの未定乗数を設定し、パラメータ調整・符号化・符号量対雑音量評価のサイクルを繰り返し、最適化を行っていた。

【０００４】

【発明が解決しようとする課題】現在広く用いられているMPEG-2（ISO／IEC 13818－2）等の高能率ビデオ符号化技術においては、フレームを小ブロックに分割し、この単位でフレーム間動き補償と符号化を行う手段を採用している。このような手段で、小ブロック毎に独立に量子化ステップ等のパラメータを設定すれば、理論上最良の最適化が可能であるが、処理が膨大となりすぎ（例えばCCIR 601画像では１フレーム内に1350個の小ブロックが存在する）、実用に適さない。実用的な時間内で処理を行う場合、最適化のサイクルにおいて調整するパラメータは各フレームに一つ用いるものしか提案されていなかった。

【０００５】例えば水野らは、繰り返し方式ではないが、最適なフレーム毎割り当て符号量を導出している（Picture coding simposium'99、“A study on bit allocationmethod based on rate-distortion properties for different coded picturetypes”）。また、K.Ramchandranらはフレーム毎の量子化パラメータを最適化調整パラメータとしている（IEEE transactions on image processing,Vol.3,No.5, September1994、“Bit allocation for dependent quantization with applications to multiresolution and MPEG video coders”）。

【０００６】いずれの方法においてもフレーム内は統一されたパラメータにより符号化され、小ブロック等、より仔細な符号化単位の考慮は割愛されており、結果として最適化の余地が本質的に残ってしまうという欠点があった。

【０００７】本発明は上記の事情に鑑みてなされたもので、実用的な処理量を保ちつつ、符号量対雑音の意味で従来よりも良好な最適化が行えるパラメータ調整の単位を決定する繰り返しビデオ信号符号化方法およびこの方法のプログラムを記録した記録媒体を提供することを課題とする。

【０００８】

【課題を解決するための手段】上記の課題を達成するために、第１の発明では、画像を小ブロックに分割しフレーム間動き補償を行い、さらに同一画像を複数回符号化するビデオ信号符号化方法において、動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順と、この被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する手順と、を有することを特徴とする繰り返しビデオ信号符号化方法である。

【０００９】第２の発明は、前記動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順が、符号化単位である小ブロック毎に、参照画像フレーム内でその小ブロックが参照している領域へ、小ブロックの属性に応じて所定の量を投票する処理と、該領域毎に投票された値を加算し、その結果を該領域の被参照度とする処理と、　この処理をそれ以上参照されない画像フレームから参照される画像フレームの順に繰り返す処理と、を有することを特徴とする繰り返しビデオ信号符号化方法である。

【００１０】第３の発明は、被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する際、被参照度とラグランジュの未定乗数を１対１に対応させる表と、与えられた未定乗数から符号化対象小ブロックのラグランジュコスト関数を求める手順と、ラグランジュコスト関数を最小にする手順と、を有することを特徴とする繰り返しビデオ信号符号化方法である。

【００１１】第４の発明は、前記ラグランジュコスト関数を最小にする手順が、小ブロック毎に、その小ブロックの被参照度に対応するラグランジュの未定乗数に応じて、ラグランジュコスト関数を最小にする量子化パラメータを求める手順と、画像シーケンス全体のラグランジュコスト関数を求める手順と、被参照度とラグランジュの未定乗数の対応を変化させ、画像シーケンス全体のラグランジュコスト関数を最小化する手順と、を有することを特徴とする繰り返しビデオ信号符号化方法である。

【００１２】第５の発明は、動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順と、この被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する手順とを、コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体である。

【００１３】第６の発明は、動きベクトル情報を用い符号化対象小ブロックの他フレームからの参照の多少を数値（以後被参照度と呼ぶことにする）化する手順が、符

号化単位である小ブロック毎に、参照画像フレーム内でその小ブロックが参照している領域へ、小ブロックの属性に応じて所定の量を投票する処理と、該領域毎に投票された値を加算し、その結果を該領域の被参照度とする処理と、　この処理をそれ以上参照されない画像フレームから参照される画像フレームの順に繰り返す処理とを、コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体である。

【００１４】第７の発明は、被参照度を用いて符号化対象小ブロックの符号量割り当てを決定する際、被参照度とラグランジュの未定乗数を１対１に対応させる表と、与えられた未定乗数から符号化対象小ブロックのラグランジュコスト関数を求める手順と、ラグランジュコスト関数を最小にする手順とを、コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体である。

【００１５】第８の発明は、ラグランジュコスト関数を最小にする手順が、小ブロック毎に、その小ブロックの被参照度に対応するラグランジュの未定乗数に応じて、ラグランジュコスト関数を最小にする量子化パラメータを求める手順と、画像シーケンス全体のラグランジュコスト関数を求める手順と、被参照度とラグランジュの未定乗数の対応を変化させ、画像シーケンス全体のラグランジュコスト関数を最小化する手順とを、コンピュータに実行させるためのプログラムを、該コンピュータが読み取り可能な記録媒体に記録したことを特徴とする繰り返しビデオ信号符号化方法のプログラムを記録した記録媒体である。

【００１６】上記のように、本発明では、画像の動きベクトル情報からフレーム間参照関係を求め、これを元に画像小ブロック毎の符号化重要度を決定する。

【００１７】処理に先立ち画像を一度符号化し、動き補償情報および符号化モード情報を決定しておく。符号化単位である小ブロック毎に、その動きベクトル情報を用い、参照画像フレーム内でその小ブロックが参照している領域へ、小ブロックの属性に応じ適当に定めた量を投票する。

【００１８】例えば、双方向予測マクロブロックであれば、参照しているフレーム（前後２枚）内の各参照領域へそれぞれ「Ｖ＝０．５」を投票する。順方向予測マクロブロックであれば、参照している時間的に過去のフレーム（１枚）内の参照領域へ「Ｖ（＝V_0＋１）」を投票する。ここでV_0は該小ブロックの加算器に既に蓄えられている投票値である。イントラ（フレーム内符号化）マクロブロックであれば、どの画像信号も参照していないので投票は行わない。

【００１９】例えば、MPEG-2ではskipped macro blockという、符号化が省略された小ブロックが存在し得るが、これは動き無し（動きベクトルが（０，０））と見做して投票を行う。またイントラマクロブロックにconcealment motion vectorという動きベクトルが付加され得る場合があるが、この動きベクトルは無視し投票は行わない。

【００２０】ここで行う投票とは、フレーム毎に準備した２次元配列状の加算器を用いた、２次元的なものである。例えば、MPEG-2のＢフレーム（双方向予測フレーム）内の全ブロックの被参照度は常に「０」であるので、加算器を省略することができる。また、Ｉフレーム（フレーム内符号化フレーム）内の全ブロックはフレーム内符号化であるので、そのフレームについて投票操作を省略することができる。加算器は、投票操作前に全て「０」に初期化する。

【００２１】MPEG-2等のような平行移動モデルを用いた方式の場合は小ブロックと同じ形状と大きさの範囲内へ投票値を加算する。MPEG-4 Version 2（ISO／IEC14496-2AMD1）のようにアフィン・透視変換モデルを用いた方式の場合は、小ブロック形状を逆変換した領域内へ投票値を加算する。後者の場合，投票領域の面積S_vは一般に小ブロックの面積S_bと異なるので、投票値をＶとしたとき、例えば

$$V' = V * S_b / S_v$$

のように修正した投票値Ｖ’を用いる。

【００２２】ここで用いる２次元加算器配列は、例えば１画素に１つ加算器が対応する構成や、１小ブロックに１つ加算器が対応する構成等が考えられる。前者の場合は、投票時、例えば投票領域内の全加算器へ投票値を加算する。後者の場合は、投票時、投票領域と小ブロックが重なっている全加算器へ、重なっている面積の割合だけ加算する。すなわち投票値をＶ、投票領域の面積をS_v、該加算器の領域と重なっている面積をS_oとすると、加算値は

$$V * S_o / S_v,$$

となる。この様子を図１に示す。図１に示す例では、予測フレームの着目小ブロックは参照フレームの四個の小ブロックにまたがっており、小ブロック面積を「１」とするとそれぞれに重なる面積が左から右、上から下の順に0.07V, 0.26V, 0.15V, 0.52Vであるため、これらの値が対応する加算器（図１では加算器を「・」のシンボルで示す）に加算される。この投票操作を、これ以上参照されないフレームから、参照される度合いの低い順に、ボトムアップに繰り返していく。この様子を図２に示す。

【００２３】この処理により、符号化対象画像信号内の全小ブロック内の加算器について、参照される度合いに関する投票結果が集積される。１画素に１つ加算器が対応している場合は、例えば小ブロック内の全加算器の出力である、投票結果の総和をその小ブロックの被参照度

とする。１小ブロックに１つ加算器が対応している場合は加算器の出力値そのものを被参照度とする。他から参照されないＢフレームについては投票値は常に「０」となるため、加算器は省略してもよい。

【００２４】各小ブロックにおいて、この被参照度が高いほど、より大きな符号化時重みを具現化するパラメータを与える。この被参照度とパラメータの対応づけは任意であるが、より高い被参照度に対してより少ない符号化雑音あるいはより多くの符号量が発生するようなパラメータとする。例えば、より小さな量子化パラメータ、あるいはより大きなラグランジュの未定乗数λ、あるいは割り当て符号量そのものをより多くする、などが考えられる。被参照度が「０」の小ブロックについては、例えば、シーケンス全体に与えるラグランジュ未定乗数そのもの（λ_0とする）を用い、量子化パラメータを求める。

【００２５】すなわち、小ブロックの符号量をR_0、誤差をE_0（ともに１フレームあるいは１シーケンスあたりの量に比例するよう正規化しておくものとする）としたとき

$L_0 = R_0 + \lambda_0 * E_0$

で定義されるラグランジュコスト関数L_0を最小とするような量子化パラメータをその小ブロックの符号化に用いる。このパラメータを逐次調整し、シーケンス全体の評価量Ｌを最小とするように最適化を行う。

【００２６】なお、上述したラグランジュコスト関数Ｌを最小にするには、次のような２重ループで最適化を図る。

【００２７】外ループ：被参照度とλの対応（図４に示す折れ線グラフ制御点）を調節する。　内ループ：小ブロック毎に、その小ブロックの被参照度に対応するλに応じてＬを最小とする量子化パラメータを総当たりで求める。

【００２８】従来のようにフレーム毎に符号量あるいは量子化パラメータあるいはラグランジュの未定乗数を与えていた場合は、ＩまたはＰフレーム（順方向予測フレーム）内に全く参照されない小領域があったり、あるＰフレーム内に非常に頻繁に参照される小領域があったとしても、符号量割り当てにおいて考慮できなかったのに対し、上記述べた方法ではより被参照度の高い小ブロックへより多くの符号量を割り当てることができ、結果としてシーケンス全体の符号化効率が改善する。

【００２９】また小ブロックの被参照度に応じパラメータ調整・最適化を行うので、小ブロック毎に異なる符号量割り当てが実現されるが、画像シーケンスの全ての小ブロックにパラメータを対応させ、最適化探索するのに比べ、演算量は大幅に小さくなる。

【００３０】

【発明の実施の形態】以下本発明の実施の形態を図面に基づいて説明する。図３は本発明の実施の形態を述べる符号化方法の処理手順のフローチャートで、図３において、まず、動き検出器０１において、入力画像信号０２の符号化モードおよび動きベクトル情報０４を抽出する。この段階では符号化は行わない。この情報はメモリ０５に保存され、また投票器０６に入力される。投票器０６は、符号化モードおよび動きベクトル情報０４から被参照度０７を求める。求められた被参照度０７はメモリ０８に保存される。

【００３１】パラメータ調整部０３において、この被参照度０７に対応する符号量割り当て優先度の度合を決定する。例えば、図４のように複数の制御点で決定される折れ線グラフにより、一つの被参照度に対し、ラグランジュの未定乗数λを一つ対応させる。被参照度が「０」の場合は、画像全体の未定乗数に等しいλ_0とする。より高い被参照度をもつ小ブロックには、より高い符号量割り当て優先度を対応させるために、例えば、図４に示す折れ線グラフを必ず右上がりとする拘束条件を用いることができる。

【００３２】また、ある被参照度を未定乗数に変換するために、被参照度とラグランジュの未定乗数を１対１に対応させた表を用いても良い。この場合、被参照度０７が小数点以下の桁を有する場合には、適当な桁で四捨五入することにより、表のサイズを抑えることができる。この対応情報を用い、優先度情報決定器０９において全小ブロックの符号量割り当て優先度（ラグランジュの未定乗数）が決定される。

【００３３】この情報およびメモリ０５からの保存動きベクトル情報を元に、ループ内符号化器１０において、再度入力画像信号０２の符号化を行う。すなわち、ある小ブロックについて、優先度情報０９から与えられるラグランジュの未定乗数がλ_Bであったとすると、そのブロックについてラグランジュコスト関数Ｌ

$L = R_B + \lambda_B E_B$

（但し、Ｒは該小ブロックのビット数、Ｅは該小ブロックの復号誤差）を最小とするような量子化パラメータを、例えば総当たりで求める。ビットストリーム出力１１は、蓄積媒体１２に上書き保存される。

【００３４】また、符号化器１０から出力される、画像シーケンス全体についての符号量Ｒ１３と総雑音量Ｅ１４を元に、コスト評価部１５ではラグランジュコスト関数Ｌを

$L = R + \lambda_0 E$

として求める。この値が最小となった場合、その符号量に対する雑音の量が最小となる。その後、収束判定部１６にて収束判定を行う。例えば、ラグランジュコスト関数Ｌに変化が見られない等の収束条件を満たしたと、判定された場合処理を終了する。

【００３５】そうでなければ、パラメータ調整部０３にて再び被参照度０７と符号量割り当て優先度の対応を調節し（実際は図４の制御点を移動させる、又は被参照度

とラグランジュの未定乗数を１対１に対応させる表を修正する）、符号化／評価／判定のループを繰り返す。処理終了時に蓄積媒体１２に保存されているビットストリームが所望の最適なビットストリームとなる。

【００３６】この実施形態ではループ内の符号化器１０では動き探索を行わないため、比較的高速に繰り返し符号化が行われる。またこの実施形態では、ループ内の画像符号化器では動きベクトルや小ブロックの符号化モード（双方向予測／順方向予測／スキップ等）の選択を固定とした符号化を行うが、動き検出やモード選択部分をループの中に入れる構成も可能である。この場合、収束判定部１６での収束判定が“Ｎｏ”であれば、動き検出器０１の直後ではなく直前へ制御が移ることになる。

【００３７】なお、図３で示した各処理手順をコンピュータに実行させることができることは言うまでもなく、コンピュータにその処理手順を実行させるためのプログラムを、そのコンピュータが読み取り可能な記録媒体、例えば、ＦＤ（フロッピー（登録商標）ディスク）や、MO、ＲＯＭ、メモリカード、ＣＤ、ＤＶＤ、リムーバブルディスクなどに記録し、提供し、配布することが可能である。

【００３８】

【発明の効果】以上述べたように、本発明によれば、フレームタイプ毎にパラメータを設定するよりも、より仔細で最適な符号量割り当てを行えるようになる。また小ブロックの被参照度に応じパラメータ調整・最適化を行うので、小ブロック毎に異なる符号量割り当てが実現さ＊れるが、画像シーケンスの全ての小ブロックにパラメータを対応させて最適化探索するのに比べ、演算量は大幅に小さくなる。

【図面の簡単な説明】

【図１】小ブロックに１つ加算器が対応する場合の加算器への投票の様子を示した説明図である。

【図２】ボトムアップの投票動作と加算処理の流れを述べる説明図である。

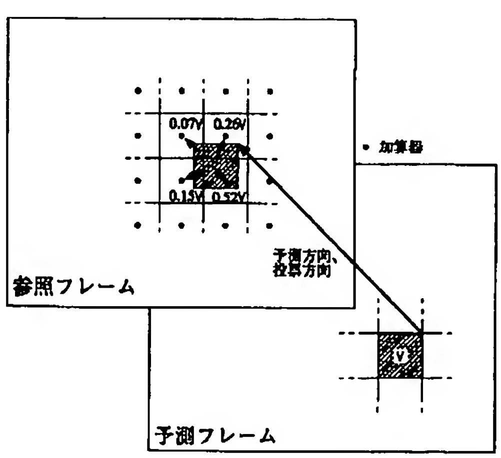
【図３】本発明の実施形態を示す符号化方法の処理手順図である。

【図４】本発明の実施形態における被参照度と符号化優先度の対応づけグラフである。

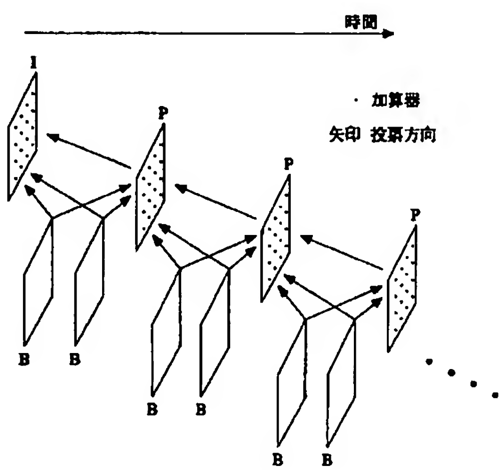
【符号の説明】

０１…動き検出器
０２…入力画像信号
０３…パラメータ調整部
０４…符号化モードおよび動きベクトル情報
０５…メモリ
０６…投票器
０７…被参照度
０８…メモリ
０９…優先度情報決定器
１０…符号化器
１２…蓄積媒体
１５…コスト評価部
１６…収束判定部

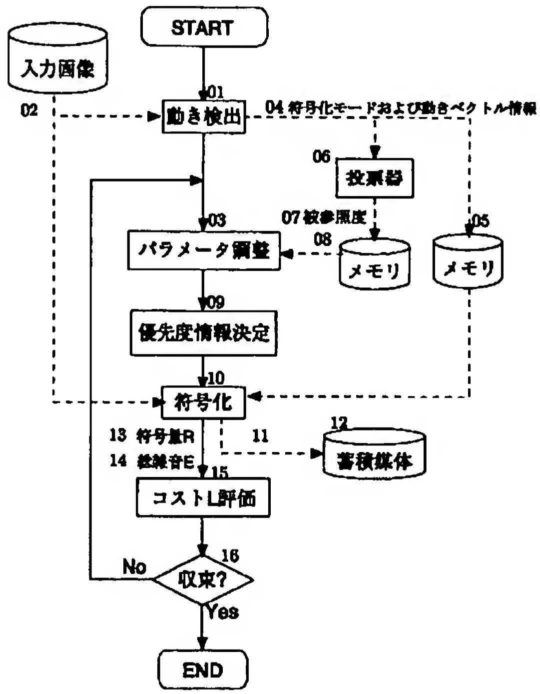
【図１】



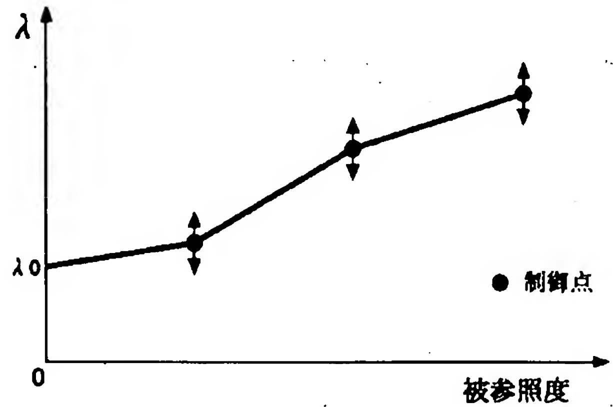
【図２】



【図３】



【図４】



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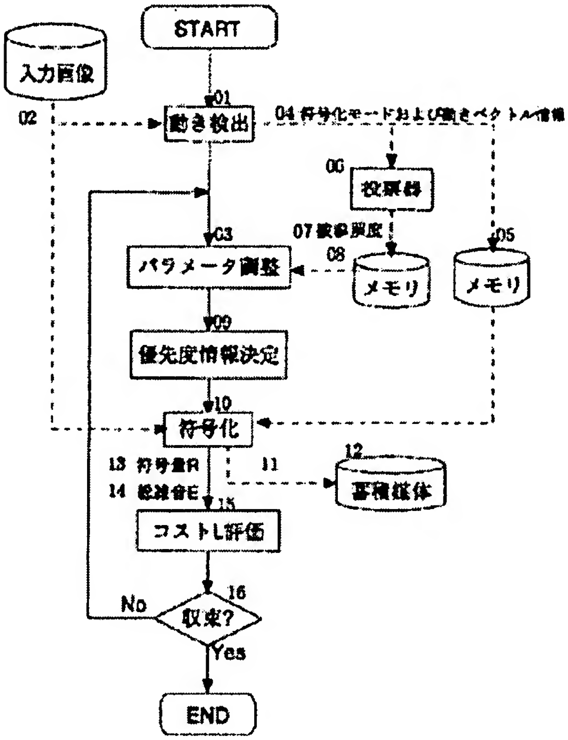
Abstract:
PROBLEM TO BE SOLVED: To determine the unit of a parameter adjustment with which a better optimization than before in the sense of code quantity to noise is performed.SOLUTION: A motion detector 01 extracts a coding mode and motion vector information 04 of an input image signal 02. The information is stored in a memory 05 and inputted in a vote device 06. A referenced degree 07 is obtained with the vote device 06, and stored in a memory 08. In a parameter adjustment part 03, the degree of the allocation priority of a code quantity corresponding to the referenced degree 07 is determined, and the allocation priority of the code quantity of all small blocks is determined by a priority information determination device 09. An encoder 10 performs the coding of an input image signal 02 based on the information and information from the memory 05. A cost evaluation part 15 obtains a Lagrange cost function L based on a code quantity R13 about the whole image sequence outputted from the encoder 10 and the total quantity E14 of noises. When the value is minimum, the noise quantity to the code quantity is minimum. Then, a convergence decision is performed in a

convergence decision part 16.



JPO Machine translation abstract:

(57) **Abstract**

SUBJECT The unit of the parameter adjustment which can perform optimization better than before in the meaning of a code amount versus noise is determined.

Means for Solution Coding mode and the motion vector information 04 of the input picture signal 02 are extracted by the motion detector 01. This information is saved in the memory 05 and inputted into the vote machine 06. It asks for the reference degree 07 with the vote machine 06, and is saved in the memory 08. In the parameter controller 03, a degree of a code amount quota priority corresponding to the reference degree 07 is determined, a code amount quota priority of all the small blocks is determined by the priority information determination machine 09, and the input picture signal 02 is coded with the coding equipment 10 based on this information and information from the memory 05. Based on the code amount R13 about the whole image sequence and the total noise quantity E14 which are outputted from the coding equipment 10, in the cost evaluation part 15, when it asks for Lagrange cost function L and this value becomes the minimum, quantity of noise over that code amount serves as the minimum. Then, a convergence test is performed in the convergence test part 16.

Claim(s)

Claim 1 In a video signal encoding method which divides a picture into a small block, performs an inter-frame motion compensation, and carries out the multiple-times coding of the identical image further, A numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information A changing procedure, A repetition video signal encoding method having the procedure of determining code amount assignment of a coding object small block using this reference degree.

Claim 2 In the repetition video signal encoding method according to claim 1, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using said motion vector information a changing procedure, Processing which votes a predetermined quantity according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame for every small block, A video signal encoding method having processing which adds a value for which its vote was cast for this every field, and makes that result a reference degree of this field, and the processing which repeats this processing in order of an image frame referred to from an image frame which is not referred to any more.

Claim 3 The repetition video signal encoding method comprising according to claim 1:

A table which makes undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 when

determining code amount assignment of a coding object small block using a reference degree.
- A procedure of asking for the Lagrange cost function of a coding object small block from given undetermined multipliers, and a procedure which makes the Lagrange cost function the minimum.

Claim 4 The repetition video signal encoding method comprising according to claim 3:
A procedure of asking for a quantization parameter to which a procedure which makes said Lagrange cost function the minimum makes the Lagrange cost function the minimum according to Lagrange's undetermined multipliers corresponding to a reference degree of the small block for every small block.
A procedure of asking for the Lagrange cost function of the whole image sequence, and a procedure which changes correspondence of undetermined multipliers of a reference degree and Lagrange, and minimizes the Lagrange cost function of the whole image sequence.

Claim 5A numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information A changing procedure, A recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure of determining code amount assignment of a coding object small block using this reference degree on a recording medium which this computer can read.
Claim 6A numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information a changing procedure, Processing which votes a predetermined quantity according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame for every small block, Processing which adds a value for which its vote was cast for this every field, and makes the result a reference degree of this field, Processing which repeats this processing in order of an image frame referred to from an image frame which is not referred to any more, A recording medium which recorded a program of a repetition video signal encoding method recording a program for performing a computer on a recording medium which this computer can read.
Claim 7A table which makes undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 when determining code amount assignment of a coding object small block using a reference degree, A procedure of asking for the Lagrange cost function of a coding object small block from given undetermined multipliers, A recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure which makes the Lagrange cost function the minimum on a recording medium which this computer can read.
Claim 8A procedure of asking for a quantization parameter to which a procedure which makes the Lagrange cost function the minimum makes the Lagrange cost function the minimum according to Lagrange's undetermined multipliers corresponding to a reference degree of the small block for every small block, Correspondence of undetermined multipliers of a procedure of asking for the Lagrange cost function of the whole image sequence, and a reference degree and Lagrange is changed, A recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure which minimizes the Lagrange cost function of the whole image sequence on a recording medium which this computer can read.

Detailed Description of the Invention
0001
Field of the Invention This invention relates to the recording medium which recorded the program of a highly efficient repetition video signal encoding method and this method.
0002
Description of the Prior Art In order to raise coding efficiency in the sense of a code amount versus noise quantity, in the video coding method of allowing coding trial of multiple times about an identical image sequence, the "Lagrange's method of undetermined multipliers" established in the 18th century is applied to evaluation of coding efficiency. They are the total code amount R and all the errors E (by a situation, this measure is a sum of squares with error, or) at the time of sequence coding to the undetermined multipliers lambda given from the outside. It asks for valuation-basis L=R+lambda*E from it being an absolute value sum with error, and this L performs optimization search (parameter adjustment) in the direction used as the minimum. L is called the Lagrange cost function.
0003 Conventionally, a quantization parameter or Lagrange's undetermined multipliers were set up per frame, and it was optimizing by repeating the cycle of parameter adjustment, coding, and code amount versus noise quantity evaluation.
0004
Problem(s) to be Solved by the Invention In highly efficient video coding art, such as MPEG-2 (ISO/IEC 13818-2) used widely now, the frame was divided into the small block and the inter-frame motion compensation and the means to code are adopted in this unit. If parameters, such as a quantization step, are independently set for every small block by such a means, the best optimization on theory is possible, but processing becomes huge too much and it is not suitable for practical use (for example, by CCIR 601 picture, 1350 small blocks exist

in one frame). When processing by within a time **practical** , only what uses for each one frame the parameter adjusted in the cycle of optimization was proposed.

0005 For example, although Mizuno and others is not a repetition method, The optimal whole frame the amount of allocation codes. It has derived (Picture coding.). simposium'99, "A study on bit allocationmethod based on rate-distortion properties for different coded picturetypes." .K. Ramchandran and others makes the quantization parameter for every frame the optimizing adjustment parameter (IEEE transactions on image processing, Vo1.3, No.5, and September1994.) "Bit allocation for dependent quantization with applications to multiresolution and MPEG video coders."

0006 Also in which method, the inside of a frame is coded with the unified parameter, consideration of details encoding units, such as a small block, is omitted, and there was a fault that the room of optimization will remain intrinsically as a result.

0007 Let it be SUBJECT to provide the recording medium which recorded the program of the repetition video signal encoding method which determines the unit of the parameter adjustment which can perform optimization better than before in the meaning of a code amount versus noise, and this method, this invention having been made in light of the above-mentioned circumstances, and maintaining a practical throughput.

0008

Means for Solving the Problem In order to attain above-mentioned SUBJECT, in the 1st invention. In a video signal encoding method which divides a picture into a small block, performs an inter-frame motion compensation, and carries out the multiple-times coding of the identical image further, A numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information A changing procedure, It is a repetition video signal encoding method having the procedure of determining code amount assignment of a coding object small block using this reference degree.

0009 As for the 2nd invention, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using said motion vector information a changing procedure, Processing which votes a predetermined quantity according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame for every small block, It is a repetition video signal encoding method having processing which adds a value for which its vote was cast for this every field, and makes that result a reference degree of this field, and the processing which repeats this processing in order of an image frame referred to from an image frame which is not referred to any more.

0010A table which makes undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 when the 3rd invention determines code amount assignment of a coding object small block using a reference degree, It is a repetition video signal encoding method having a procedure of asking for the Lagrange cost function of a coding object small block from given undetermined multipliers, and a procedure which makes the Lagrange cost function the minimum.

0011A procedure which makes said Lagrange cost function the minimum the 4th invention for every small block. A procedure of asking for a quantization parameter which makes the Lagrange cost function the minimum according to Lagrange's undetermined multipliers corresponding to a reference degree of the small block, It is a repetition video signal encoding method having a procedure of asking for the Lagrange cost function of the whole image sequence, and a procedure which changes correspondence of undetermined multipliers of a reference degree and Lagrange, and minimizes the Lagrange cost function of the whole image sequence.

0012 As for the 5th invention, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information A changing procedure, A procedure of determining code amount assignment of a coding object small block using this reference degree, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for performing a computer on a recording medium which this computer can read.

0013 As for the 6th invention, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information a changing procedure, Processing which votes a predetermined quantity according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame for every small block, Processing which adds a value for which its vote was cast for this every field, and makes the result a reference degree of this field, Processing which repeats this processing in order of an image frame referred to from an image frame which is not referred to any more, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for performing a computer on a recording medium which this computer can read.

0014A table which makes undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 when the 7th invention determines code amount assignment of a coding object small block using a reference degree, A procedure of asking for the Lagrange cost function of a coding object small block from given undetermined multipliers, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure which makes the Lagrange cost function the minimum on a recording medium which this computer can read.

0015A procedure which makes the Lagrange cost function the minimum the 8th invention for every small block.

A procedure of asking for a quantization parameter which makes the Lagrange cost function the minimum according to Lagrange's undetermined multipliers corresponding to a reference degree of the small block, Correspondence of undetermined multipliers of a procedure of asking for the Lagrange cost function of the whole image sequence, and a reference degree and Lagrange is changed, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure which minimizes the Lagrange cost function of the whole image sequence on a recording medium which this computer can read.

0016 As mentioned above, in this invention, it asks for inter-frame reference relation from motion vector information of a picture, and coding importance for every picture small block is determined based on this.

0017 In advance of processing, a picture is coded once, and motion compensation information and encoded mode information are determined. Quantity suitably defined according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame using the motion vector information for every small block is voted.

0018 For example, if it is a bidirectional prediction macro block, "V= 0.5" will be voted, respectively to each reference region in a frame (before or after two sheets) currently referred to. If it is a forward direction prediction macro block, "V $(=V_0+1)$" will be voted for a time target which is referring to it to a reference region in the past frame (one sheet). V_0 is a voting value already stored in an adding machine of this small block here. If it is the Intra (formation of frame inner code) macro block, since all picture signal is not referred to, either, vote will not be performed.

0019 For example, although a small block which is called skipped macro b1ock and to which coding was abbreviated may exist in MPEG-2, this casts its vote by ****(ing) with those without a motion (motion vectors are (0, 0)). Although a motion vector called concealment motion vector may be added to the Intra macro block, this motion vector ignores and vote is not performed.

0020 Vote performed here is a two-dimensional thing using a two-dimensional array-like adding machine prepared for every frame. For example, since a reference degree of a whole block in the B frame (bidirectional prediction frame) of MPEG-2 is always "0", an adding machine is omissible. Since there is a whole block in the I frame (frame inner code-ized frame) by frame inner code-ization, voting operation is omissible about the frame. An adding machine is altogether initialized to "0" before voting operation.

0021 In the case of a method using a parallel translation model like MPEG-2 grade, a voting value is added to within the limits of the same shape as a small block, and a size. In the case of a method using affine and a transparent transformation model, a voting value is added like MPEG-4 Version 2 (ISO/IEC14496-2AMD1) into a field which transformed small block shape inversely. the latter -- a case -- vote -- a field -- area -- S -- $_{\text{-- v --}}$ -- general -- a small block -- area -- S -- $_{\text{-- b --}}$ -- differing -- since -- a voting value -- V -- having carried out -- the time -- for example -- V -- ' -- = -- $V*S_b$ -- -- /-- S -- $_{\text{-- v --}}$ -- like -- having corrected -- a voting value -- V -- ' -- using .

0022 The two-dimensional adding machine arrangement used here can consider composition corresponding to 1 pixel in one adding machine, composition corresponding to 1 small block in one adding machine, etc., for example. In the case of the former, a voting value is added, for example to a full adder in a vote field at the time of vote. In the case of the latter, only a rate of area of having lapped is added to a full adder with which a small block has lapped with a vote field at the time of vote. That is, an aggregate value will become $V*S_0/S_v$ if area which has lapped area of V and a vote field with a field of S_v and this adding machine in a voting value is made into S_0. This situation is shown in drawing 1. In an example shown in drawing 1, a view small block of a prediction frame is straddling four small blocks of a reference frame, Since area which laps with each is 0.07V-0.26V-0.15V-0.52V in order of the right and a top to the bottom from the left when small block area is set to "1", it is added to an adding machine (at drawing 1, a symbol of "-" shows an adding machine) with which these values correspond. This voting operation is repeated bottom-up in low order of a degree referred to from a frame which is not referred to any more. This situation is shown in drawing 2.

0023 Ballot results about a degree referred to are accumulated by this processing about an adding machine in all the small blocks within an encoding object image signal. When one adding machine supports 1 pixel, let total of ballot results which is an output of a full adder in a small block, for example be a reference degree of the small block. When one adding machine supports 1 small block, let the output value of an adding machine itself be a reference degree. Since a voting value is always set to "0" about the B frame which is not referred to from others, an adding machine may be omitted.

0024 In each small block, a parameter which embodies dignity at the time of bigger coding is given, so that this reference degree is high. Although matching of this reference degree and a parameter is arbitrary, it is considered as a parameter which smaller coding noise or more code amounts generate to a higher reference degree. For example, it is possible to make more the undetermined multipliers lambda or the amount of allocation codes itself of a smaller quantization parameter or bigger Lagrange etc. A reference degree asks for a quantization parameter about a small block of "0", for example using the Lagrange undetermined multipliers (it is considered as lambda_0) themselves given to the whole sequence.

0025A code amount of a small block Namely, R_0, When an error is made into E_0 (it shall normalize so that it

may both be proportional to quantity per one frame or 1 sequence). A quantization parameter which makes the minimum Lagrange cost function L_0 defined by $L_0=R_0+lambda_0*E_0$ is used for coding of the small block. This parameter is adjusted one by one, and it optimizes so that evaluation quantity L of the whole sequence may be made into the minimum.

0026 In order to make into the minimum Lagrange cost function L mentioned above, optimization is attained by the following double loops.

0027 Outside loop: Adjust correspondence (line graph control point shown in drawing 4) of a reference degree and lambda. Inner loop: Ask for a quantization parameter which makes L the minimum according to lambda corresponding to a reference degree of the small block as a round robin for every small block.

0028 When a code amount, a quantization parameter, or Lagrange's undetermined multipliers are given for every frame like before, Even if a small region which is not referred to at all is in I or p frames (forward direction prediction frame) or a small region referred to very frequently is in a certain p frames, To the ability to have not taken into consideration in code amount assignment, by an upper description poor method, many code amounts can be assigned and encoding efficiency of the whole sequence improves as a result from small BUROKKUHE with a higher reference degree.

0029 Since parameter adjustment and optimization are performed according to a reference degree of a small block, different code amount assignment for every small block is realized, but a parameter is made to correspond to all the small blocks of an image sequence, and an operation amount becomes small substantially compared with carrying out optimization search.

0030

Embodiment of the Invention An embodiment of the invention is described based on Drawings below. Drawing 3 is a flow chart of the procedure of the encoding method which describes an embodiment of the invention, and extracts the coding mode and the motion vector information 04 of the input picture signal 02 in the motion detector 01 first in drawing 3. Coding is not performed in this stage. This information is saved in the memory 05, and is inputted into the vote machine 06. The vote machine 06 asks for the reference degree 07 from coding mode and the motion vector information 04. The called-for reference degree 07 is saved in the memory 08.

0031 In the parameter controller 03, the degree of the code amount quota priority corresponding to this reference degree 07 is determined. For example, the one undetermined multipliers lambda of Lagrange are made to correspond to one reference degree by the line graph determined like drawing 4 at two or more control points. When a reference degree is "0", it is considered as $lambda_0$ equal to the undetermined multipliers of the whole picture. In order to make a higher code amount quota priority correspond, the constraint which certainly makes the line graph shown in drawing 4 an upward slant to the right, for example can be used for a small block with a higher reference degree.

0032 In order to change a certain reference degree into undetermined multipliers, the table which made the undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 may be used. In this case, when the reference degree 07 has a beam below a decimal point, the size of a table can be stopped by rounding off with a suitable beam. In the priority information determination machine 09, the code amount quota priority (Lagrange's undetermined multipliers) of all the small blocks is determined using this matching information.

0033 Based on this information and the preservation motion vector information from the memory 05, the input picture signal 02 is again coded in the loop inner code-ized machine 10. Namely, about a certain small block, supposing Lagrange's undetermined multipliers given from the priority information 09 are $lambda_B$, It asks for a quantization parameter which makes the minimum Lagrange cost function $LL=R_B+lambda_B E_B$ (however, R the number of bits of this small block and E decoding error of this small block) about the block as a round robin, for example. The bit stream output 11 is overwritten at the storage medium 12.

0034 In the cost evaluation part 15, it asks for Lagrange cost function L as $L=R+lambda_0 E$ based on the code amount R13 about the whole image sequence and the total noise quantity E14 which are outputted from the coding equipment 10. When this value becomes the minimum, the quantity of the noise over that code amount serves as the minimum. Then, a convergence test is performed in the convergence test part 16. For example, processing is ended when judged with having fulfilled the condition of convergence -- change is not looked at by Lagrange cost function L.

0035 Otherwise, correspondence of the reference degree 07 and a code amount quota priority is again adjusted by the parameter controller 03 (the control point of drawing 4 is moved in practice, or the table which makes the undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 is corrected), and the loop of coding / evaluation / judgment is repeated. The bit stream saved at the storage medium 12 at the time of the end of processing turns into optimal desired bit stream.

0036 At comparatively high speed, in order not to search this embodiment by moving by the coding equipment 10 within a loop, coding is performed repeatedly. Although the coding which considered selection of the coding modes (bidirectional prediction / forward direction prediction / skip) of a motion vector or a small block as immobilization is performed by the picture encoder within a loop at this embodiment, the composition which puts motion detection and a mode select portion in a loop is also possible. In this case, if the convergence test in the convergence test part 16 is "No", control will move to just before **instead of immediately after the motion detector 01** .

0037 It cannot be overemphasized that a computer can be made to perform each procedure shown by drawing 3, To a computer the program for performing the procedure The recording medium which the computer can read, For example, it records on FD (floppy (registered trademark) disk), MO, ROM, a memory card, CD, DVD, a removable disc, etc., and it provides and distributing is possible.

0038

Effect of the Invention As stated above, according to this invention, optimal code amount assignment can be performed more by details rather than setting a parameter for every frame type. Since parameter adjustment and optimization are performed according to the reference degree of a small block, different code amount assignment for every small block is realized, but compared with making a parameter correspond to all the small blocks of an image sequence, and carrying out optimization search, an operation amount becomes small substantially.

Field of the Invention This invention relates to the recording medium which recorded the program of a highly efficient repetition video signal encoding method and this method.

Description of the Prior Art In order to raise coding efficiency in the sense of a code amount versus noise quantity, in the video coding method of allowing coding trial of multiple times about an identical image sequence, the "Lagrange's method of undetermined multipliers" established in the 18th century is applied to evaluation of coding efficiency. They are the total code amount R and all the errors E (by a situation, this measure is a sum of squares with error, or) at the time of sequence coding to the undetermined multipliers lambda given from the outside. It asks for valuation-basis L=R+lambda*E from it being an absolute value sum with error, and this L performs optimization search (parameter adjustment) in the direction used as the minimum. L is called the Lagrange cost function.

0003 Conventionally, a quantization parameter or Lagrange's undetermined multipliers were set up per frame, and it was optimizing by repeating the cycle of parameter adjustment, coding, and code amount versus noise quantity evaluation.

Effect of the Invention As stated above, according to this invention, optimal code amount assignment can be performed more by details rather than setting a parameter for every frame type. Since parameter adjustment and optimization are performed according to the reference degree of a small block, different code amount assignment for every small block is realized, but compared with making a parameter correspond to all the small blocks of an image sequence, and carrying out optimization search, an operation amount becomes small substantially.

Problem(s) to be Solved by the Invention In highly efficient video coding art, such as MPEG-2 (ISO/IEC 13818-2) used widely now, the frame was divided into the small block and the inter-frame motion compensation and the means to code are adopted in this unit. If parameters, such as a quantization step, are independently set for every small block by such a means, the best optimization on theory is possible, but processing becomes huge too much and it is not suitable for practical use (for example, by CCIR 601 picture, 1350 small blocks exist in one frame). When processing by within a time **practical** , only what uses for each one frame the parameter adjusted in the cycle of optimization was proposed.

0005 For example, although Mizuno and others is not a repetition method, The optimal whole frame the amount of allocation codes. It has derived (Picture coding.). simposium'99, "A study on bit allocationmethod based on rate-distortion properties for different coded picturetypes." .K. Ramchandran and others makes the quantization parameter for every frame the optimizing adjustment parameter (IEEE transactions on image processing, Vo1.3, No.5, and September1994.) "Bit allocation for dependent quantization with applications to multiresolution and MPEG video coders."

0006 Also in which method, the inside of a frame is coded with the unified parameter, consideration of details encoding units, such as a small block, is omitted, and there was a fault that the room of optimization will remain intrinsically as a result.

0007 Let it be SUBJECT to provide the recording medium which recorded the program of the repetition video signal encoding method which determines the unit of the parameter adjustment which can perform optimization better than before in the meaning of a code amount versus noise, and this method, this invention having been made in light of the above-mentioned circumstances, and maintaining a practical throughput.

Means for Solving the Problem In order to attain above-mentioned SUBJECT, in the 1st invention. In a video signal encoding method which divides a picture into a small block, performs an inter-frame motion compensation, and carries out the multiple-times coding of the identical image further, A numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information A changing procedure, It is a repetition video signal encoding method having the procedure of determining code amount assignment of a coding object small block using this reference degree.
0009 As for the 2nd invention, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using said motion vector information a changing procedure, Processing which votes a predetermined quantity according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame for every small block, It is a repetition video signal encoding method having processing which adds a value for which its vote was cast for this every field, and makes that result a reference degree of this field, and the processing which repeats this processing in order of an image frame referred to from an image frame which is not referred to any more.
0010A table which makes undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 when the 3rd invention determines code amount assignment of a coding object small block using a reference degree, It is a repetition video signal encoding method having a procedure of asking for the Lagrange cost function of a coding object small block from given undetermined multipliers, and a procedure which makes the Lagrange cost function the minimum.
0011A procedure which makes said Lagrange cost function the minimum the 4th invention for every small block. A procedure of asking for a quantization parameter which makes the Lagrange cost function the minimum according to Lagrange's undetermined multipliers corresponding to a reference degree of the small block, It is a repetition video signal encoding method having a procedure of asking for the Lagrange cost function of the whole image sequence, and a procedure which changes correspondence of undetermined multipliers of a reference degree and Lagrange, and minimizes the Lagrange cost function of the whole image sequence.
0012 As for the 5th invention, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information A changing procedure, A procedure of determining code amount assignment of a coding object small block using this reference degree, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for performing a computer on a recording medium which this computer can read.
0013 As for the 6th invention, a numerical value (it will be henceforth called a reference degree) some of references from other frames of a coding object small block using motion vector information a changing procedure, Processing which votes a predetermined quantity according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame for every small block, Processing which adds a value for which its vote was cast for this every field, and makes the result a reference degree of this field, Processing which repeats this processing in order of an image frame referred to from an image frame which is not referred to any more, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for performing a computer on a recording medium which this computer can read.
0014A table which makes undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 when the 7th invention determines code amount assignment of a coding object small block using a reference degree, A procedure of asking for the Lagrange cost function of a coding object small block from given undetermined multipliers, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure which makes the Lagrange cost function the minimum on a recording medium which this computer can read.
0015A procedure which makes the Lagrange cost function the minimum the 8th invention for every small block. A procedure of asking for a quantization parameter which makes the Lagrange cost function the minimum according to Lagrange's undetermined multipliers corresponding to a reference degree of the small block, Correspondence of undetermined multipliers of a procedure of asking for the Lagrange cost function of the whole image sequence, and a reference degree and Lagrange is changed, It is the recording medium which recorded a program of a repetition video signal encoding method recording a program for making a computer perform a procedure which minimizes the Lagrange cost function of the whole image sequence on a recording medium which this computer can read.
0016 As mentioned above, in this invention, it asks for inter-frame reference relation from motion vector information of a picture, and coding importance for every picture small block is determined based on this.
0017 In advance of processing, a picture is coded once, and motion compensation information and encoded mode information are determined. Quantity suitably defined according to the attribute of a small block to a field which is an encoding unit, and which the small block is referring to within an image comparison frame using the motion vector information for every small block is voted.
0018 For example, if it is a bidirectional prediction macro block, "V= 0.5" will be voted, respectively to each

reference region in a frame (before or after two sheets) currently referred to. If it is a forward direction prediction macro block, "V ($=V_0+1$)" will be voted for a time target which is referring to it to a reference region in the past frame (one sheet). V_0 is a voting value already stored in an adding machine of this small block here. If it is the Intra (formation of frame inner code) macro block, since all picture signal is not referred to, either, vote will not be performed.
0019 For example, although a small block which is called skipped macro b1ock and to which coding was abbreviated may exist in MPEG-2, this casts its vote by ****(ing) with those without a motion (motion vectors are (0, 0)). Although a motion vector called concealment motion vector may be added to the Intra macro block, this motion vector ignores and vote is not performed.
0020 Vote performed here is a two-dimensional thing using a two-dimensional array-like adding machine prepared for every frame. For example, since a reference degree of a whole block in the B frame (bidirectional prediction frame) of MPEG-2 is always "0", an adding machine is omissible. Since there is a whole block in the I frame (frame inner code-ized frame) by frame inner code-ization, voting operation is omissible about the frame. An adding machine is altogether initialized to "0" before voting operation.
0021 In the case of a method using a parallel translation model like MPEG-2 grade, a voting value is added to within the limits of the same shape as a small block, and a size. In the case of a method using affine and a transparent transformation model, a voting value is added like MPEG-4 Version 2 (ISO/IEC14496-2AMD1) into a field which transformed small block shape inversely. the latter -- a case -- vote -- a field -- area -- S -- $_{\text{-- v --}}$ -- general -- a small block -- area -- S -- $_{\text{-- b --}}$ -- differing -- since -- a voting value -- V -- having carried out -- the time -- for example -- V -- ' -- = -- V^*S_b $_{\text{--}}$ -- /-- S -- $_{\text{-- v --}}$ -- like -- having corrected -- a voting value -- V -- ' -- using .
0022 The two-dimensional adding machine arrangement used here can consider composition corresponding to 1 pixel in one adding machine, composition corresponding to 1 small block in one adding machine, etc., for example. In the case of the former, a voting value is added, for example to a full adder in a vote field at the time of vote. In the case of the latter, only a rate of area of having lapped is added to a full adder with which a small block has lapped with a vote field at the time of vote. That is, an aggregate value will become V^*S_0/S_v if area which has lapped area of V and a vote field with a field of S_v and this adding machine in a voting value is made into S_0. This situation is shown in drawing 1. In an example shown in drawing 1, a view small block of a prediction frame is straddling four small blocks of a reference frame, Since area which laps with each is 0.07V-0.26V-0.15V-0.52V in order of the right and a top to the bottom from the left when small block area is set to "1", it is added to an adding machine (at drawing 1, a symbol of "-" shows an adding machine) with which these values correspond. This voting operation is repeated bottom-up in low order of a degree referred to from a frame which is not referred to any more. This situation is shown in drawing 2.
0023 Ballot results about a degree referred to are accumulated by this processing about an adding machine in all the small blocks within an encoding object image signal. When one adding machine supports 1 pixel, let total of ballot results which is an output of a full adder in a small block, for example be a reference degree of the small block. When one adding machine supports 1 small block, let the output value of an adding machine itself be a reference degree. Since a voting value is always set to "0" about the B frame which is not referred to from others, an adding machine may be omitted.
0024 In each small block, a parameter which embodies dignity at the time of bigger coding is given, so that this reference degree is high. Although matching of this reference degree and a parameter is arbitrary, it is considered as a parameter which smaller coding noise or more code amounts generate to a higher reference degree. For example, it is possible to make more the undetermined multipliers lambda or the amount of allocation codes itself of a smaller quantization parameter or bigger Lagrange etc. A reference degree asks for a quantization parameter about a small block of "0", for example using the Lagrange undetermined multipliers (it is considered as lambda_0) themselves given to the whole sequence.
0025A code amount of a small block Namely, R_0, When an error is made into E_0 (it shall normalize so that it may both be proportional to quantity per one frame or 1 sequence). A quantization parameter which makes the minimum Lagrange cost function L_0 defined by $L_0=R_0+\text{lambda}_0{}^*E_0$ is used for coding of the small block. This parameter is adjusted one by one, and it optimizes so that evaluation quantity L of the whole sequence may be made into the minimum.
0026 In order to make into the minimum Lagrange cost function L mentioned above, optimization is attained by the following double loops.
0027 Outside loop: Adjust correspondence (line graph control point shown in drawing 4) of a reference degree and lambda. Inner loop: Ask for a quantization parameter which makes L the minimum according to lambda corresponding to a reference degree of the small block as a round robin for every small block.
0028 When a code amount, a quantization parameter, or Lagrange's undetermined multipliers are given for every frame like before, Even if a small region which is not referred to at all is in I or p frames (forward direction prediction frame) or a small region referred to very frequently is in a certain p frames, To the ability to have not taken into consideration in code amount assignment, by an upper description poor method, many code amounts

can be assigned and encoding efficiency of the whole sequence improves as a result from small BUROKKUHE with a higher reference degree.

0029 Since parameter adjustment and optimization are performed according to a reference degree of a small block, different code amount assignment for every small block is realized, but a parameter is made to correspond to all the small blocks of an image sequence, and an operation amount becomes small substantially compared with carrying out optimization search.

0030

Embodiment of the Invention An embodiment of the invention is described based on Drawings below. Drawing 3 is a flow chart of the procedure of the encoding method which describes an embodiment of the invention, and extracts the coding mode and the motion vector information 04 of the input picture signal 02 in the motion detector 01 first in drawing 3. Coding is not performed in this stage. This information is saved in the memory 05, and is inputted into the vote machine 06. The vote machine 06 asks for the reference degree 07 from coding mode and the motion vector information 04. The called-for reference degree 07 is saved in the memory 08.

0031 In the parameter controller 03, the degree of the code amount quota priority corresponding to this reference degree 07 is determined. For example, the one undetermined multipliers lambda of Lagrange are made to correspond to one reference degree by the line graph determined like drawing 4 at two or more control points. When a reference degree is "0", it is considered as lambda_0 equal to the undetermined multipliers of the whole picture. In order to make a higher code amount quota priority correspond, the constraint which certainly makes the line graph shown in drawing 4 an upward slant to the right, for example can be used for a small block with a higher reference degree.

0032 In order to change a certain reference degree into undetermined multipliers, the table which made the undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 may be used. In this case, when the reference degree 07 has a beam below a decimal point, the size of a table can be stopped by rounding off with a suitable beam. In the priority information determination machine 09, the code amount quota priority (Lagrange's undetermined multipliers) of all the small blocks is determined using this matching information.

0033 Based on this information and the preservation motion vector information from the memory 05, the input picture signal 02 is again coded in the loop inner code-ized machine 10. Namely, about a certain small block, supposing Lagrange's undetermined multipliers given from the priority information 09 are lambda_B, It asks for a quantization parameter which makes the minimum Lagrange cost function $LL=R_B+\text{lambda}_B E_B$ (however, R the number of bits of this small block and E decoding error of this small block) about the block as a round robin, for example. The bit stream output 11 is overwritten at the storage medium 12.

0034 In the cost evaluation part 15, it asks for Lagrange cost function L as $L=R+\text{lambda}_0 E$ based on the code amount R13 about the whole image sequence and the total noise quantity E14 which are outputted from the coding equipment 10. When this value becomes the minimum, the quantity of the noise over that code amount serves as the minimum. Then, a convergence test is performed in the convergence test part 16. For example, processing is ended when judged with having fulfilled the condition of convergence -- change is not looked at by Lagrange cost function L.

0035 Otherwise, correspondence of the reference degree 07 and a code amount quota priority is again adjusted by the parameter controller 03 (the control point of drawing 4 is moved in practice, or the table which makes the undetermined multipliers of a reference degree and Lagrange correspond to 1 to 1 is corrected), and the loop of coding / evaluation / judgment is repeated. The bit stream saved at the storage medium 12 at the time of the end of processing turns into optimal desired bit stream.

0036 At comparatively high speed, in order not to search this embodiment by moving by the coding equipment 10 within a loop, coding is performed repeatedly. Although the coding which considered selection of the coding modes (bidirectional prediction / forward direction prediction / skip) of a motion vector or a small block as immobilization is performed by the picture encoder within a loop at this embodiment, the composition which puts motion detection and a mode select portion in a loop is also possible. In this case, if the convergence test in the convergence test part 16 is "No", control will move to just before **instead of immediately after the motion detector 01** .

0037 It cannot be overemphasized that a computer can be made to perform each procedure shown by drawing 3, To a computer the program for performing the procedure The recording medium which the computer can read, For example, it records on FD (floppy (registered trademark) disk), MO, ROM, a memory card, CD, DVD, a removable disc, etc., and it provides and distributing is possible.

Brief Description of the Drawings

Drawing 1 It is an explanatory view showing the situation of the vote to an adding machine in case one adding machine corresponds to a small block.

Drawing 2 It is an explanatory view which describes the flow of bottom-up vote operation and summing processing.

Drawing 3 It is a procedure figure of an encoding method showing the embodiment of this invention.

Drawing 4 It is a matching graph of a reference degree and an encoding priority in the embodiment of this invention.

Description of Notations

01 -- Motion detector
02 -- Input picture signal
03 -- Parameter controller
04 -- Coding mode and motion vector information
05 -- Memory
06 -- Vote machine
07 -- Reference degree
08 -- Memory
09 -- Priority information determination machine
10 -- Coding equipment
12 -- Storage medium
15 -- Cost evaluation part
16 -- Convergence test part

Drawing 1

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 4

For drawings please refer to the original document.

For drawings please refer to the original document.
